Establishing Function, Process, and Landscape Structure Objectives for Large Scale Ecosystem Restoration

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Objectives of Discussion

- Introduce WRDA 2007 Authorization
- Discuss Science Panel Recommendation to Establish Function, Process, Composition and Structure Objectives
- Describe Multi-Attribute Ranking Techniques for Future Project Evaluation

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Upper Mississippi River System, Navigation and Ecosystem Sustainability Program

- Authorized in WRDA 2007
- Navigation Improvements and Restoration
  - Small Scale (moorings, switchboats, scheduling) $256 million
  - New Locks (Locks 20, 21, 22, 24, 25 LaGrange and Peoria) $1.95 billion
- System Adaptive Mitigation $300 million

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NESP Ecosystem Restoration

- **Sec 8004. (b) (1) IN GENERAL. —The Secretary shall carry out, consistent with requirements to avoid adverse effects on navigation, ecosystem restoration projects to attain and maintain the *sustainability* of the ecosystem of the Upper Mississippi River and Illinois River…**

- **Sec 8004. (h) (2) PRIORITY. —The ranking system shall give greater weight to projects that restore *natural river processes*,…**

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Ecosystem restoration projects may include--

A) island building;
(B) construction of fish passages;
(C) floodplain restoration;
(D) water level management (including water drawdown);
(E) backwater restoration;
(F) side channel restoration;
(G) wing dam and dike restoration and modification;
(H) island and shoreline protection;
(I) topographical diversity;
(J) dam point control;
(K) use of dredged material for environmental purposes;
(L) tributary confluence restoration;
(M) spillway, dam, and levee modification to benefit the environment; and
(N) land and easement acquisition.

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NESP Ecosystem Restoration

- First Increment – 15 years
  - $1.7 billion
  - 274 projects
  - 35,000 floodplain acres acquired
  - Four fish passage
- Full Project – 50 years
  - $5 billion
  - 1009 projects
  - 105,000 floodplain acres acquired

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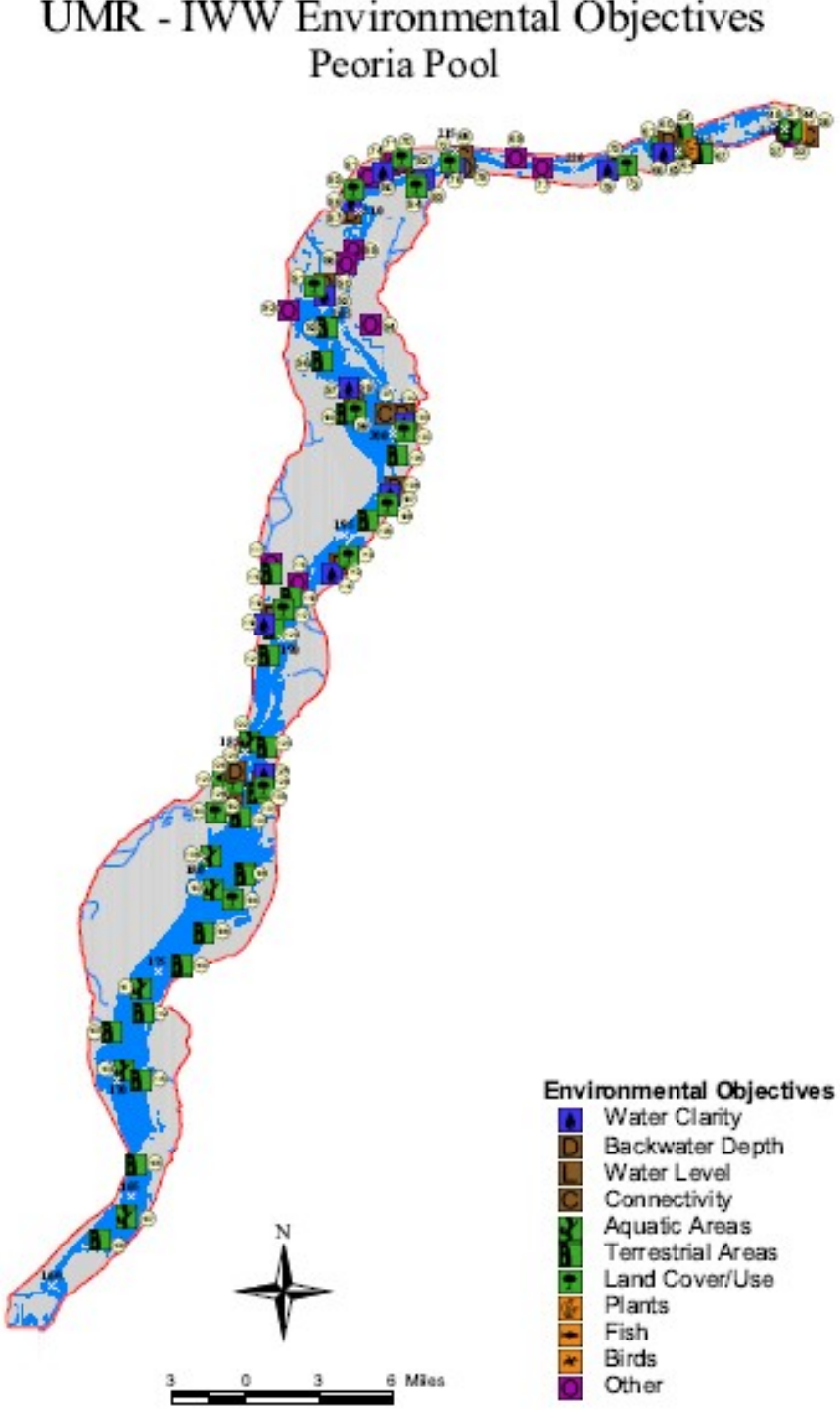
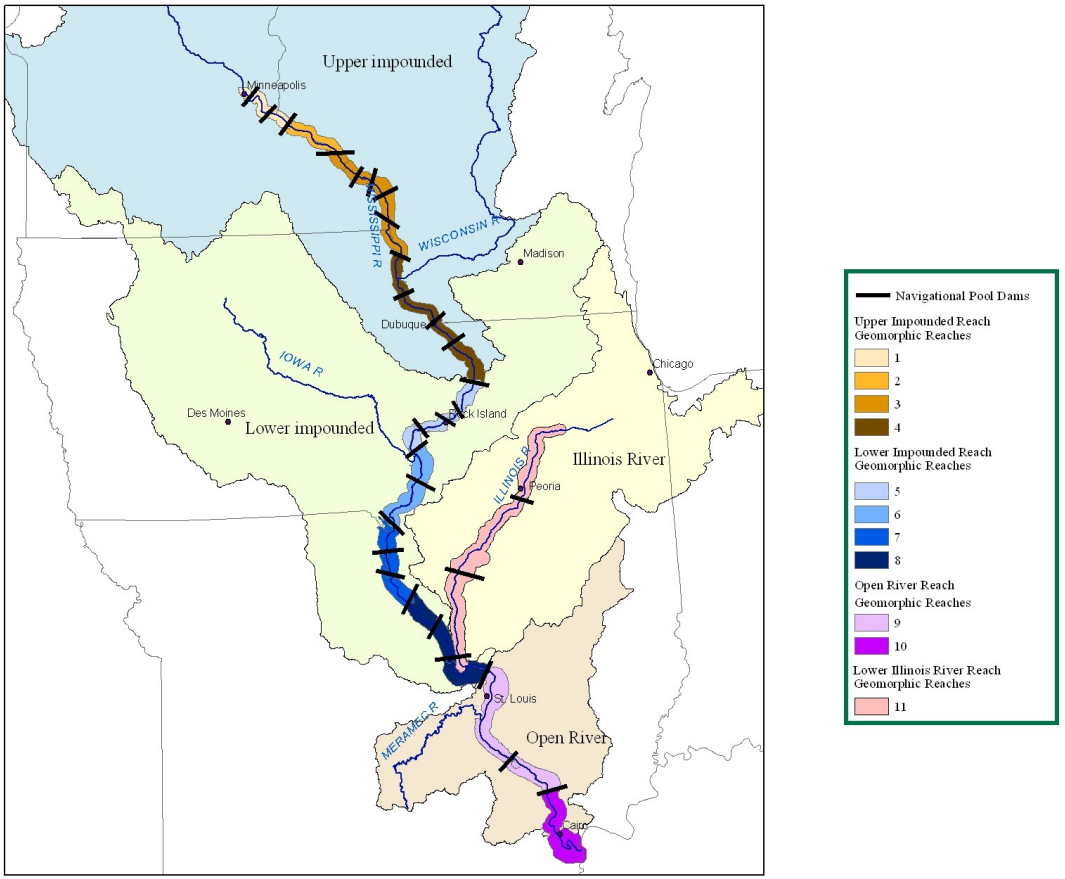
Prior Estimates of Site-Specific Restoration Objectives

- Water Clarity
- Geomorphology
- Water Levels
- Connectivity
- Pattern of Habitats
- Plants and Animals



Establishing System-wide Goals & Objectives for the UMRS

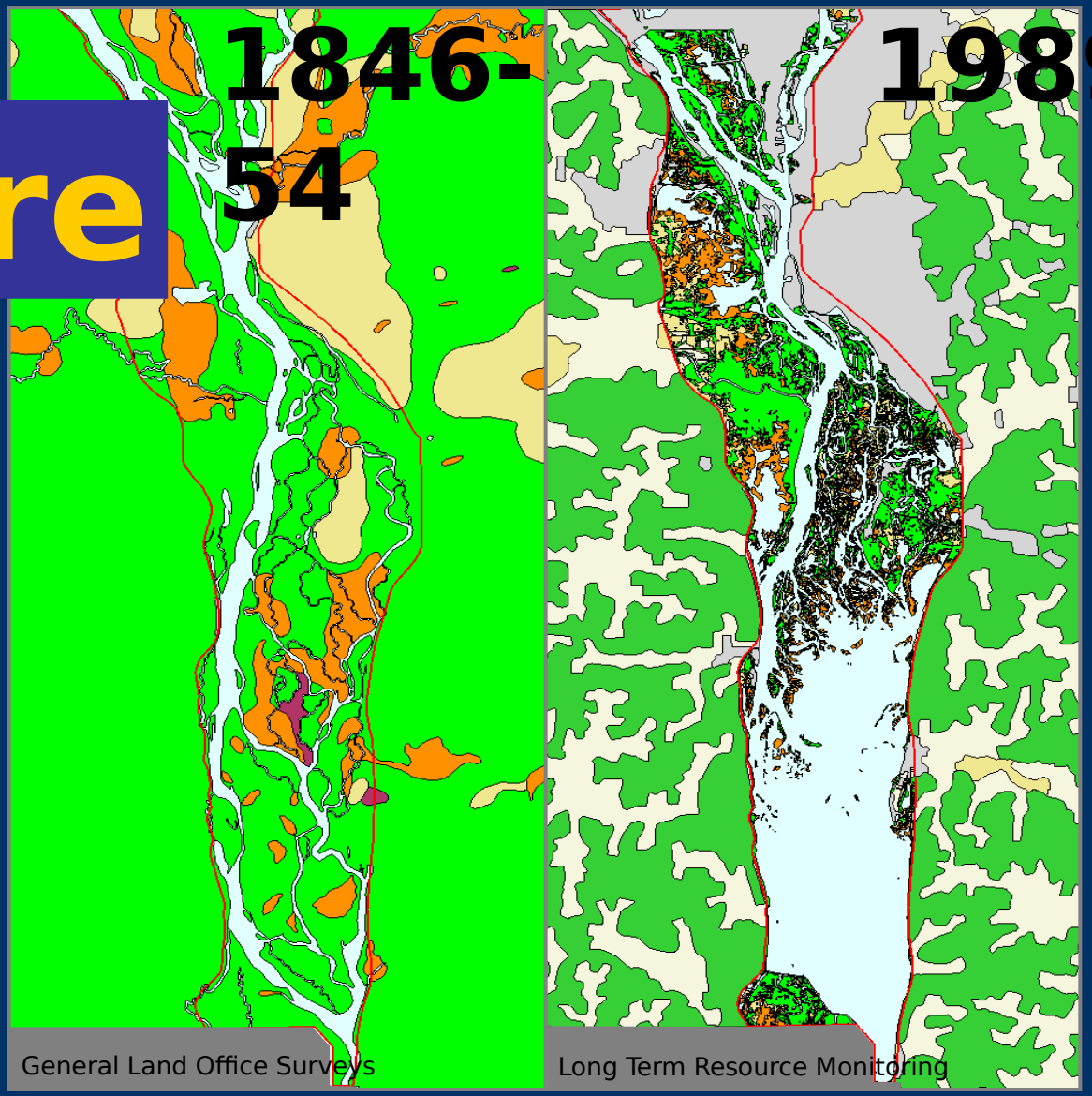
Recommendation of the NESP Science Panel



***Structure*: the parts of the whole or the architecture of a community. (SER 2004)**

Structure

Upper Impounded Reach – Pool



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Function

Function: **the dynamic attributes of ecosystems, including density of organisms, interactions among organisms, and interactions between organisms and their**

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Proces

Water-level management and ergent plant production (kg biomass/yr)

1.

2.

3.

4

Process: **rates of essential ecosystem functions, such as population growth, photosynthetic rate, decomposition rate, dispersal rate.** **(SER 2004)**

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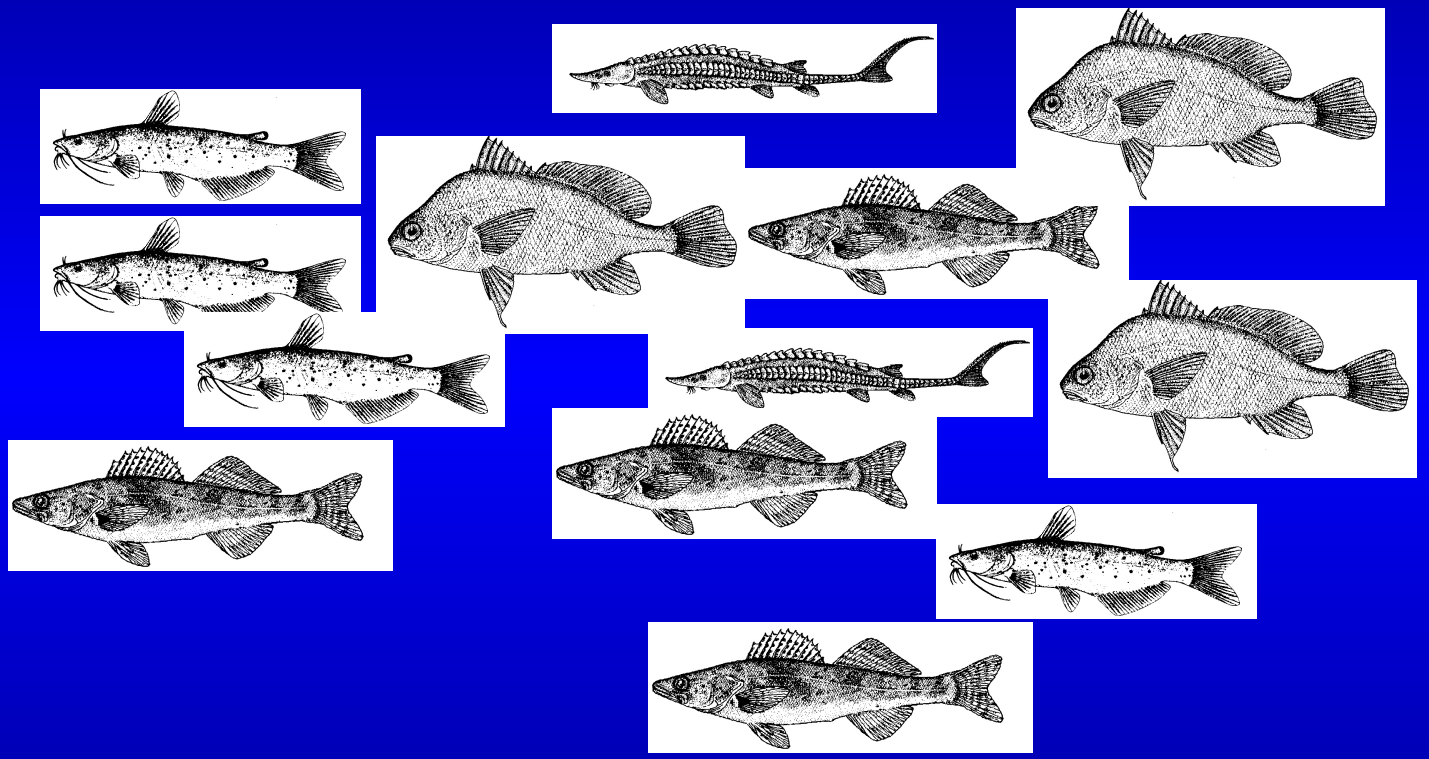
Composition



***Composition*: the taxonomic array of species present, and species richness. (SER 2004)**

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A System-wide Approach Emphasizes Processes Over Sites

Site-based objective: Provide over-wintering habitat for Centrarchids every 5-7 miles in the Middle Mississippi River.

Process-based objective: Increase over-winter survival of Centrarchids in the Middle Mississippi River

Avoid substituting activities for outcomes,
projects for performance

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A System-wide Approach Emphasizes Processes Over Sites

Site-based objective: Provide over-wintering habitat for fishes every 5-7 miles in the Middle Mississippi River.

Process-based objective: Increase over-winter survival of fishes in the Middle Mississippi River

Be less prescriptive,
Consider full life history needs, and
Emphasize biotic outcomes

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Proposed NESP System-wide Goals

Manage for:

- **A more natural hydrologic regime (hydrology & hydraulics);**
- **Processes that shape a diverse and dynamic river channel (geomorphology);**
- **Processes that input, transport, assimilate, and output materials within UMR basin river-floodplains: water quality, sediments, and nutrients (biogeochemistry);**
- **A diverse and dynamic pattern of habitats to support native biota (habitat), and;**
- **Viable populations of native species and diverse plant and animal communities (biota).**

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Potential Reach Scale Objectives

Physical Process	Landscape	Biological Process/Species
Nutrient Cycling	Forest	Biodiversity
Energy Flow	Mesic Forest	Genetic Factors
Water Flow	Grass/Prairie	Species/Population
Hydroperiods	Agriculture	Resilience to Disturbance
Sediment Transport	Emergent Aquatic Veg	Primary Production
Delta Formation/Erosion	Submersed Aquatic Veg	Secondary Production
Channel Alluviation	Open Water	

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Steps to Achieve Ecosystem Restoration Objectives

- Review historic reference conditions, inventory of existing conditions, forecasted future conditions for the reach.
- Identify factors most limiting to biota in the reach. Strive to link these factors to elements of the UMRS conceptual model.
- Identify the most important ecosystem structures (biota composition, river landscape pattern) and functions and processes in need of restoration or conservation in the reach.
- Clearly develop a small number (less than 10) of reach-scale objectives for the important ecosystem structures and functions in need of restoration or conservation.

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Structured Decision Making: Multi-Attribute Ranking Technique

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What is Structured Decision Making?

- A concept rather than a particular method
- A means to decompose decision problems to identify solutions that bring you closest to your objectives
- A means to reduce subjectivity.
- Transparent framework for making choices
- Techniques include formal “hard” modeling approaches to “soft” techniques

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Simple Multi-Attribute Ranking Technique

INPUT

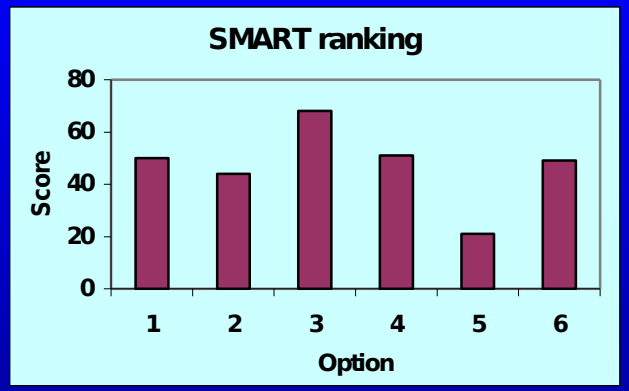
Enter thermometer scores (T) in orange boxes
Optional: change the goal weights (W)

"THERMOMETER SCORES" (T)						
Option (k)	Goal (j)					
	1	2	3	4	5	6
1	100	24	89	0	70	68
2	0	34	46	100	70	2
3	50	100	50	67	100	60
4	45	33	50	67	89	44
5	24	0	0	3	15	92
6	0	4	100	40	21	100

WEIGHTS (W)						
Goal (j)						
1	2	3	4	5	6	
50	75	75	100	25	75	
				The sum of the weights (S) =	400	

OUTPUT

Option (k)	Weighted Sum (V)	FINAL SCORE V[k]/S
1	20325	**50**
2	17900	**44**
3	27450	**68**
4	20700	**51**
5	8775	**21**
6	19825	**49**



SMART in symbols:

Let W[j] be the Weight for goal number j
Then S = W[1] + W[2] + …. + W[6]

Let T[k,j] be the score for Option k on Thermometer (Goal) j.

Then the weighted sum for Option k is
V[k] = W[1]*T[k,1] + W[2]*T[k,2] + … + W[6]*T[k,6]

The Final Score for Option k is then just V[k]/S

Simple Multi-Attribute Ranking Technique

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INPUT

Enter thermometer scores (T) in orange boxes
Optional: change the goal weights (W)

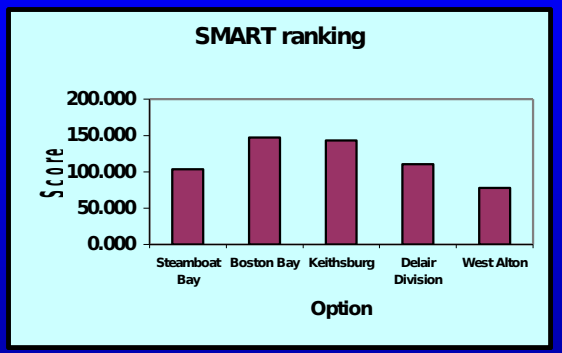
"THERMOMETER SCORES" (T)							
Option	Goal (j)						
(k)	Forest	Grass	Island	Wetland	Backwater	SC	MC
Sboat	24	0	0	181	357	0	0
Bbay	47	0	0	200	570	0	0
Kburg	187	0	0	420	112	0	0
Delair	97	75	0	350	0	0	0
WAlton	0	0	22	2	450	0	0

WEIGHTS (W)						
Goal (j)						
1	2	3	4	5	6	7
75	100	50	100	75	25	25

The sum of the weights (S) =	450

OUTPUT

Option (k)	Weighted Sum (V)	FINAL SCORE V[k]/S
Sboat	46675	103.722
Bbay	66275	147.278
Kburg	64425	143.167
Delair	49775	110.611
WAlton	35050	77.889



SET Example:

- recommended 7 spatial/habitat goals
- Scores = acres
- Weights determined by District Evaluation Teams
- Weights include benefits and "urgency" as considerations

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Process for NESP Project Development

You Are Here

Project Engineering & Design

River Council

Field Knowledge Built into RFPs (Fact Sheets)

Science Evaluation (Fact Sheet Ranking)

Project Cost Estimation

Policy & Administrative Ranking